

Dr David's Essential Chemistry Definitions

Some Definitions for GCE Chemistry

Chemistry definitions are statements of the precise meanings of chemical terms.

A GCE examination question may start by asking for a particular definition. Usually they carry two marks and in order to achieve full marks the definition must be correct in all respects. It is well worth while learning these definitions so that you are word perfect!

AS Chemistry:

Relative isotopic mass:

The mass of an atom of the isotope of an element compared with the mass of $1/12$ of a ^{12}C atom.

Relative atomic mass:

The average mass of an atom of an element compared with the mass of $1/12$ of a ^{12}C atom.

Relative molecular mass:

The average mass of a molecule (or formula unit) of a compound compared with $1/12$ of an atom of ^{12}C . It is the sum of the relative atomic masses of the elements in the compound.

Mole:

It is the chemists unit of amount of a substance. It is defined as that amount which contains as many particles (eg, in the case of an element it would be *atoms*, in the case of an organic compound it would be *molecules* and in the case of an inorganic compound it would be *ions*) as there are atoms in 12g of the carbon-12 isotope (ie, 6.02×10^{23}).

Molar mass:

The mass in grams of one mole of the substance.

First ionisation energy:

The energy change per mole for the process: $\text{E(g)} \rightarrow \text{E}^+(\text{g}) + \text{e}^-$

Second ionisation energy:

The energy change per mole for the process: $\text{E}^+(\text{g}) \rightarrow \text{E}^{2+}(\text{g}) + \text{e}^-$

First electron affinity:

The energy change per mole for the process: $\text{E(g)} + \text{e}^- \rightarrow \text{E}^-(\text{g})$

Second electron affinity:

The energy change per mole for the process: $\text{E}^-(\text{g}) + \text{e}^- \rightarrow \text{E}^{2-}(\text{g})$. This is always endothermic.

Avogadro Number (or, Avogadro Constant):

The number of particles present in 1 mole of a substance.

It has a numerical value of $6.02 \times 10^{23} \text{ mol}^{-1}$

Oxidation number:

The difference between the number of electrons associated with an element in a compound and the element itself.

Just for the purpose of assigning oxidation numbers all compounds are considered to contain ions, eg, CO_2 , $\text{C}^{4+} 2\text{O}^{2-}$ (but in reality, CO_2 is molecular and the bonding is covalent).

Standard conditions:

At 1 atmosphere pressure (101.3 kPa) and 298 K (25°C).

In the case of standard solutions they would have a concentration of 1 mole per dm^3 .

Standard enthalpy of formation:

The enthalpy change when 1 mole of a compound is formed from its elements in their standard states, under standard conditions.

Standard enthalpy of combustion:

The enthalpy change when 1 mole of a compound is burnt completely in excess oxygen under standard conditions.

Standard enthalpy of neutralisation:

The enthalpy change when a specified acid neutralises a specified base in dilute aqueous solution to form 1 mole of water under standard conditions.

Electrophile:

A species that seeks out areas of high electron density and accepts an electron pair to form a covalent bond when it reacts. eg, H^+ , Br^+ , SO_3 , NO_2^+ .

Nucleophile:

A species that has a lone pair of electrons and is able to attack positive regions in other molecules and form covalent (dative) bonds. eg, :OH^- (hydroxide ion), :CN^- (cyanide or nitrile ion), :NH_3 .

Free radical:

A reactive atom or group which has an unpaired electron. This unpaired electron can combine with another to form a covalent bond. eg, $\text{Cl}\cdot$ (a chlorine atom and free radical), $\text{CH}_3\cdot$ (a methyl free radical).

Electrophilic addition:

A reaction of an electrophile involving addition across a carbon-carbon double bond to give an addition product. eg, reaction of ethene with bromine or hydrogen bromide.

Nucleophilic substitution:

A reaction of a nucleophile in which the nucleophile substitutes for another atom or group in the molecule. eg, hydrolysis of haloalkanes, halogenation of alcohols.

Elimination:

A reaction where a small molecule is lost (eliminated) from within a single molecule, usually to give a carbon-carbon double bond. eg, loss of water from alcohols to give alkenes.

Hydrolysis:

A reaction in which a molecule is decomposed by the action of water. The reaction may be catalysed by acids or alkalis. eg, the alkaline hydrolysis of a haloalkane to an alcohol.

Reduction:

In ionic reactions it is the addition of electrons to a substance. eg, the conversion of iodine atoms to iodide ions. More generally, it is a chemical change which makes the oxidation number of a reactant species (such as an element) more negative or less positive.

Oxidation:

In ionic reactions it is the removal of electrons from a substance. eg, the conversion of iron(II) to iron(III). More generally, it is a chemical change which makes the oxidation number of a reactant species (such as an element) more positive or less negative.

Polymerisation:

A reaction in which many small molecules (monomers) join up in a long chain to form a macromolecule. eg, ethene polymerises to give polyethene.

Catalyst:

A positive catalyst speeds up a chemical reaction by providing an alternative reaction path with a lower activation energy. Negative catalysts do the opposite.

Concentration:

The amount of substance in solution expressed as moles per dm^3 .

A2 Chemistry:

For A2 you will need to remember the following in addition to those you learnt for AS.

Enthalpy of atomisation:

The enthalpy change when 1 mole of isolated gaseous atoms is formed from the element in its standard state (1 atmosphere pressure and 298K).

Enthalpy of hydration:

The enthalpy change when 1 mole of gaseous ions is completely hydrated in water to infinite dilution under standard conditions.

Lattice energy:

The enthalpy change per mole for the process: $M^+(g) + X^-(g) \longrightarrow MX(s)$

Partial pressure:

It is the pressure exerted by a gas, A, in a mixture and is given by, $p_A = x_A \cdot P_{\text{total}}$, where x_A = mole fraction and P_{total} is the total pressure exerted by the mixture.

It is the pressure the gas would exert if it alone occupied the volume of the mixture.

Ideal gas equation:

$PV = nRT$, where P = pressure Nm^{-2} , V = volume m^3 , T = absolute temperature K , n = moles of the gas, R = gas constant $8.314 \text{ J}^{-1} \text{ mol}^{-1}$.

pH:

$-\log[H^+]$

K_a :

The acid dissociation constant, eg, for $HA(aq) \rightleftharpoons H^+(aq) + A^-(aq)$ $K_a = \frac{[H^+][A^-]}{[HA]}$

It has the units, mol dm^{-3} .

K_w :

The ionic product of water, ie, $K_w = [H^+][OH^-]$

pK_a :

$-\log K_a$.

pK_w :

$-\log K_w$.

Standard electrode potential:

The potential of an electrode compared with a standard hydrogen electrode, where all solutions are 1 mol dm^{-3} and gases are at 1 atmosphere pressure and the temperature is as stated (commonly, 298K).

Rate constant:

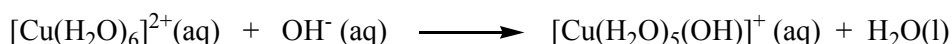
The proportionality constant in the rate equation. It relates the rate of reaction to the concentrations of the reactants. For a first order reaction it has the units time^{-1} and for a second order reaction it has the units $\text{concentration}^{-1} \text{ time}^{-1}$.

Half life:

The time taken for the concentration of a reagent to halve during a chemical reaction.

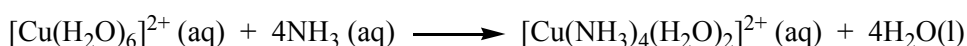
Deprotonation:

This is a chemical change in which a group loses a proton. It is usually applied to the effect of hydroxide ions on hydrated complex ions. eg,



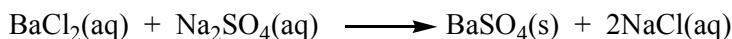
Ligand exchange:

This is the process where one type of ligand, in a complex ion, is replaced by another. eg,



Precipitation reaction:

This is the reaction of two soluble salts to give one soluble and one insoluble salt. eg,

**Asymmetric carbon atom:**

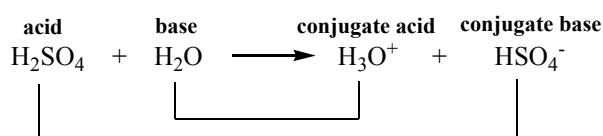
This is a carbon atom which is attached to four different atoms or groups of atoms. An asymmetric carbon atom is often referred to being a chiral centre.

Chiral molecule:

A molecule that is non-superimposable on its mirror image; such a molecule is optically active (meaning that it will rotate the plane of plane polarised light to the right or to the left). Chiral molecules frequently contain one or more asymmetric carbon atoms.

Conjugate acid-base pairs:

These are formed when an acid dissociates: eg,

**Condensation polymerisation:**

This is a reaction between two different types of molecule to give a polymer accompanied by the loss of a small molecule such as water or hydrogen chloride. eg, the formation of nylon 6,6 from reaction between hexane-1,6-diamine and hexanedioyl dichloride; in this case HCl is lost in the polymerisation.

Fingerprint region:

This is the region of the infra-red spectrum of a substance between approximately 900 cm^{-1} and 1500 cm^{-1} where the pattern of the peaks is characteristic of that compound. The origin of all the peaks, in this region, may not be known.